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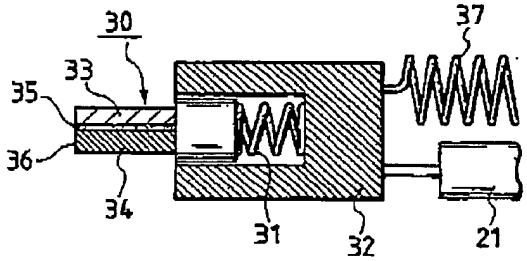
(54) **Ink jet type recording apparatus and method of cleaning a recording head.**

(57) An ink jet type recording apparatus comprises a recording head (1) of ink jet type for jetting ink droplets from a nozzle to form a dot pattern on a recording medium and a cleaning unit (5) which is moved in and out of the path of movement of the recording head when required, and made up of a spatula-shaped elastic blade member (33) and a water-absorbing rubbing member (34) bonded to the member. In the case where the nozzle surface of the recording head is to be cleaned with the rubbing member, the cleaning operation is carried out with the rubbing member (34) wetted with ink. In cleaning the nozzle surface with the blade member (33), the latter is abutted against the recording head (1) as it is.

FIG. 3



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This invention relates to ink jet type recording apparatuses with nozzles for jetting ink droplets, and more particularly to an ink jet type recording apparatus with cleaning means for removing solidified ink, dust, fibers, etc. from the nozzle surface of the recording head.

In an ink jet type recording apparatus, a small quantity of ink is jetted, in the form of droplets, from the nozzles of the recording bead by the energy produced by a piezo-electric oscillator or heat generating element, thus forming characters, patterns, etc. on a recording medium The energy produced by the piezo-electric element or heat generating element to fly ink droplets is low, and therefore the gap between the nozzle surface and the recording medium is extremely small, not more than several millimeters. Hence, when colliding with the recording medium, the ink droplets are splashed back towards the recording head, thus sticking onto the nozzle surface. The ink droplets thus stuck attract fibers coming out of the recording medium and dust in the surrounding air to cause them to stick to the nozzle surface. The fibers and dust thus stuck may clog up the nozzle openings.

The recording head of ink jet type has a number of nozzles extremely small in diameter. Those nozzles are liable to be clogged up as was described above, and in addition they may be clogged up by the solvent of the ink itself. In order to overcome this difficulty, in general the ink jet type recording apparatus has a capping member for hermetically sealing the nozzles, and an ink discharge restoring function of applying negative pressure to the capping member to forcibly discharge ink from the nozzles. However, this ink discharge restoring operation suffers from a difficulty that ink discharged from the nozzles is splashed on the nozzle surface, so that, similarly as in the case where ink is splashed during printing, fibers coming out of the recording medium or dust in the air may stick to the nozzle surface.

In order to clean the nozzle surface which has been contaminated by ink splashed in various manners as was described above, the ink jet type recording apparatus has means for cleaning the nozzle surface.

For instance, Japanese Utility Patent Application (OPI) No. 5647/1986 (the term "OPI" as used herein means an "unexamined published application") has disclosed an ink jet type recording apparatus having a cleaning unit which comprises: a first cleaning member made of a porous plate such as a sponge; and a second cleaning member made of a rubber plate. The first and second cleaning members are arranged in such a manner that the front end portions of them are free with the rear end portions fixed, and the free front end portions are held protruded into the path of movement of the recording head.

With the apparatus, whenever the recording head is moved in one direction, the first cleaning member (porous plate) wetted with a solution rubs the nozzle surface of the recording head; and whenever the recording head is moved in the opposite direction, the second cleaning member scrapes the solution off the nozzle surface. Thus, the nozzle surface is maintained substantially clean at all times.

The size of those cleaning members is selected in compliance with the size of the nozzle surface of the ink jet type recording head; that is, it is considerably small. Hence, it is considerably difficult for them to have an elastic strength enough to provide a contact pressure required for cleaning the nozzle surface. That is, the above-described cleaning unit suffers from difficulties that, since the first and second cleaning members are fixed only at the rear ends, they are low in elasticity, and the solidified ink or fibers removed by the cleaning operation are liable to enter the gap between the first and second cleaning members.

US Patent Serial No. 4,951,066 has disclosed a cleaning unit comprising a blade member of rubber, and a rubbing member made of a porous sheet which are both arranged outside of the printing region. The cleaning unit is advantageous in that those members are positively brought into elastic contact with the nozzle surface, so that the contaminants are positively wiped off and the solution is also positively scraped off; however, it is still disadvantageous in that it is rather intricate in construction because it needs means for driving the first and second cleaning members.

It is therefore an object of this invention to provide an improved ink jet type recording apparatus with suitable cleaning means and a method of cleaning a recording head. This object is solved according to the present invention by means of the ink jet type recording apparatus according to any one of independent claims 1,8,9,14, and 16 and the cleaning method according to any one of the independent method claims 6,10, and 12. Further advantageous features, details and aspects of the invention are evident from the dependent claims, the description and the drawings. The claims are intended to be understood as a first non-limiting approach of defining the invention in general terms.

Accordingly, a first aspect of this invention is to provide an ink jet type recording apparatus provided with a cleaning unit which is simple in construction and can be miniaturized, and which is able to positively remove contaminants from the recording head.

A second aspect of the invention is to provide an ink jet type recording apparatus provided with a cleaning unit which is able to effectively prevent

the recontamination of the recording head.

According to one aspect the invention provides an ink jet type recording apparatus comprising: a recording head of ink jet type for jetting ink droplets from nozzles to form a dot pattern on a recording medium, cleaning means which is moved in and out of the path of movement of the recording head when required; and drive means for moving the cleaning means to a position where the cleaning means is brought into contact with the nozzle surface of the recording head and to a position where the cleaning means is not in contact therewith; in which according to the invention, the cleaning means comprises: a spatula-shaped elastic blade member; and a water-absorbing rubbing member bonded to the blade member, and one of the edges of the blade member and the rubbing member is selectively brought into contact with the nozzle surface of the recording head with the aid of the elasticity of the blade member.

FIG. 1 is a view showing a structure of an ink jet type recording apparatus with a cleaning unit according to one embodiment of the present invention;

FIG. 2 is a block diagram showing a cleaning operation control unit used in the ink jet type recording apparatus of FIG. 1;

FIG. 3 is a sectional view showing a cleaning unit used in the ink jet type recording apparatus of FIG. 1;

FIG. 4 in a flow chart showing a first cleaning method in an ink jet type recording apparatus according to the present invention;

FIGS. 5a to 5d and 6a to 6d are explanatory diagrams showing operations of a recording head and a cleaning unit according to the first cleaning method, respectively;

FIGS. 7a, 7b, 8a and 8b are enlarged diagrams showing a cleaning element according to a modified embodiment of the present invention;

FIG. 9 is a flow chart showing a second cleaning method in an in jet type recording apparatus according to the present invention;

FIGS. 10a through 10d are explanatory diagrams showing an operation of a cleaning unit according to the present invention, respectively;

FIGS. 11 and 13 are block diagrams showing a timing control means to be realized by a microcomputer, respectively;

FIGS. 12 and 14 are block diagrams illustrative of the function of a microcomputer constituting the timing control means of FIGS. 11 and 13, respectively;

FIGS. 15 and 16 are flow charts showing the operation of the timing control means of FIGS. 11 and 13, respectively;

FIG. 17a is a front view showing a drive means used in an ink jet type recording device according to a second embodiment of the present invention; and

FIGS. 17b and 17c are aids views showing the operation of a drive means shown in FIG 11a, respectively.

Preferred embodiments of this invention will be described with reference to the accompanying drawings.

An ink jet type recording apparatus with a cleaning unit according to the invention, as shown in FIG. 1, comprises: an ink jet type recording head 1 mounted on a carriage 4 which is reciprocated on guide members 2 along the axis of a platen 3 so that the head is moved to the printing region, and to a cleaning unit 5 and a capping unit 6 arranged outside the printing region. The carriage 4 is coupled through a timing belt 7 to a carriage driving electric motor 8. The platen 3 is coupled through a train of gears to a platen driving electric motor 10.

When at rest, the recording head 1 is positioned as indicated by the dotted lines, where it is capped by the capping unit 6, so that the ink is prevented from being dried. Furthermore, when necessary, the nozzle surface of the recording head is cleaned by the cleaning unit 5.

Further in FIG. 1, reference numeral 11 designates a cleaning operation control unit for controlling the operations of the recording head 1, the cleaning unit 5, the capping unit 6, and the carriage driving motor 8 to perform a cleaning operation.

The cleaning operation control unit 11, as shown in FIG. 2, comprises: timing control means 20 for detecting the movement of the carriage, to determine operations for members concerning the cleaning operation; solenoid drive means 22 for activating drive means 21 provided for the cleaning unit 5 in response to a timing signal; suction pump driving means 24 for controlling the operation of a suction pump 23 connected to the capping unit 6; valve driving means 26 for operating (opening or closing) an air valve 25 connected to the capping unit 6; flushing means 27 for discharging ink from the recording head 1 in an ink discharge restoring operation; and carriage driving means 28 for moving the recording head 1 to the capping unit and to the cleaning unit 5 to clean it.

FIG. 3 show the cleaning unit 5 in detail. In FIG. 3, reference numeral 30 designates a cleaning element, the rear end portion of which is coupled through a compression spring 31 to a frame 32. The cleaning element 30 is formed by bonding a blade member 33 and a rubbing member 34 together with an elastic adhesive of rubber or silicon series in such a manner that the front end faces of them are flush with each other. The blade member 33 is formed by molding a material much as silicon rubber or butyl rubber relatively high in elasticity, being substantially in the form of a spatula. The

rubbing member 34 is made of unwoven cloth high both in hygroscopicity and in wear resistance; however, it goes without saying that it may be formed using a foamed material.

In a cleaning operation with the blade member 33, the latter 33 is pushed against the nozzle surface of the recording head at a pressure of the order of 10 to 50 g., to remove a liquid such as ink from the nozzle surface. On the other hand, the rubbing member 34 is used to remove an extremely sticky material. Therefore, in a cleaning operation with the rubbing member 34, a relative high pressure, about 50 to 150 g., is employed.

In the case where the blade member 33 is a rubber place 1.0 mm in thickness, 8 mm in length, 15 mm in width, and 40° in hardness while the rubbing member 34 is a piece of unwoven cloth 1.3 mm in thickness, 8 mm in length, and 15 mm in width, a pressure of the order of 40 g. is applied to the nozzle surface when the latter is wiped with the blade member 33, and a pressure of the order of 130 g. when rubbed with the rubbing member 34. The unwoven cloth itself is not stiff, and cannot provide a pressure as high as 130 g. However, the rubbing member 34 of unwoven cloth, being supported by the blade member 33 of silicon rubber from behind, can provide a pressure high enough to rub the nozzle surface.

The frame 32 is secured to the base of the recording apparatus body through a tension spring 37 and an electromagnetic plunger 31 in such a manner that the end face 36 confronts with the nozzle surface of the recording head 1. The tension spring 37 is so energized that the end face 36 of the rubbing member 34 is retracted from the path of movement of the recording head 1. The electromagnetic plunger 21 is so designed that, when energized, it causes the end face of the cleaning element 30 to go across the path along which the nozzle surface of the recording head 1 is moved.

A first cleaning operation with the unit thus constructed will be described.

When, during printing, the printing quality is lowered, the recording head 1 (FIG. 5a) is returned from the printing region to its home position; i.e., its standby position (Step 60 in FIG. 4), where the nozzle surface 1a of the recording head 1 is sealed with the capping unit 6. When, under this condition, the suction pump 23 is operated with the valve 25 closed, negative pressure is applied to the nozzles so that ink is discharged from the nozzles into the capping space (step 61 in FIG. 4, and FIG. 5b); that is, an ink discharge restoring operation is carried out. Thereafter, the capping unit 6 is disconnected from the recording head 1, and then the latter 1 is moved towards the printing region, as indicated at the arrow B in FIG. 5c (Step 62 in FIG. 4). When the nozzle openings of the recording head 1 are confronted with the rubbing member 34 of the cleaning element 30 (Step 63 in FIG. 4, and FIG. 5c), the flushing means is operated to cause the recording head 1 to discharge ink through the nozzles (Stop 64 in FIG. 4). As a result, the rubbing member 34 of the cleaning unit 5 is wetted with the ink thus discharged. When the recording head 1 has passed through the cleaning element 30 (Step 65 in FIG. 4), the electromagnetic plunger 21 is excited to cause the end face of the cleaning element 30 to go in the direction of the arrow C in FIG. 5 across the path of movement of the nozzle surface (step 66 in FIG. 4, and FIG. 5d). Thereafter, the recording head 1 is moved in the opposite direction, towards the capping unit 6 (Step 67 in FIG. 4) until the nozzle surface 1a of the recording head 1 is brought into contact with the cleaning element 30. When, under this condition, the recording head 1 is further moved, the cleaning element 30 is pushed against the side of the recording head 1, so that the cleaning element 30 is elastically deformed in such a manner that the end portion is bent towards the capping unit 6, being laid over the recording head 1. Thus, only the rubbing member 34 comes into contact with the nozzle surface 1a of the recording head 1 (FIG. 7a). When, under this condition, the recording head 1 is further moved towards the capping unit 6 (in the direction of the arrow D in FIG. 7b), only the rubbing member 34 wetted with ink is brought into contact with the nozzle surface 1a of the recording nozzle. When, under this condition, the recording head 1 is moved towards the capping unit 6, the rubbing member 34 wetted with ink rubs the nozzle openings (FIG. 6a, and FIG. 7b), thus removing solidified ink or dust therefrom. In this rubbing operation, as is seen from FIG. 7b, the rubbing member 34 is elastically deformed with the aid of the silicon rubber blade 33, so that only its end portion is brought into contact with the nozzle openings to wipe off the ink solution and the solidified ink.

In the case where, although the recording head 1 has passed through the cleaning unit 5 (FIG. 6b), the wiping operation should be carried out again (Step 68 in FIG. 4), the carriage 4 is moved in the opposite direction to move the recording head 1 towards the printing region. As a result, the recording head 1 is abutted against the cleaning element, 30 (FIG. 8a), so that the end portion of the latter 30 is elastically bent towards the printing region. That is, the edge of the blade member 33 is brought into contact with the nozzle surface, thus removing a thin layer of ink therefrom which has not been removed (FIG. 6c, and FIG. 8b).

In the case where the printing operation has been suspended to clean the nozzle surface, after the nozzle surface has been cleaned up in the above-described manner the electromagnetic

plunger 21 is deenergized to retract the cleaning element 30 from the path of movement of the nozzle (in the direction of the arrow F in FIG. 6d, and then the recording head is moved to the printing region, to resume the printing operation. In the case where the cleaning operation has been carried out with the apparatus at rest, the electromagnetic plunger 21 is deenergized so that the end portion of the cleaning element 30 is retracted from the path of movement of the recording head, and then the carriage 4 is moved in the opposite direction to move the recording head 1 to the capping unit 6, so that recording head 1 is sealed by the latter 6 (FIG. 6d).

In the cleaning element 30, the elastic blade member 33 is set on the side of the capping unit, and the rubbing member 34 of flexible unwoven cloth is on the side of the printing region. Therefore, the wiping operation which is more frequently carried out than the rubbing operation when the apparatus is at rest or after the ink discharge restoring operation, can be achieved merely by moving the recording head 1 to the printing region with the plunger 21 energized. That is, the movement of the recording head 1 to the printing region can be utilized for the cleaning operation. After the recording head 1 has passed through the cleaning element 30, the latter 30 is elastically restored by its own elasticity to the original position. In this operation, the blade member 33 is elastically bent towards the capping unit, so that the solidified ink and dust stuck to the nozzle surface during cleaning are thrown towards the capping unit 6; that is, the recording sheet is prevented from being contaminated thereby.

In the above-described embodiment, before the cleaning operation starts, ink is flushed from the nozzles to wet the cleaning element 30. However, when it is immediately after the ink discharge restoring operation, this flushing operation may be omitted.

That is, the recording head 1 is moved to the standby position (Step 70 in FIG. 9), where the nozzle surface 1a of the recording head 1 is sealed with the capping unit 6. Under this condition, the suction pump 23 is operated to forcibly suck out ink; that is, the ink discharge restoring operation is carried out (FIG. 10a). Normally, after the suction of ink, the valve 25 is opened so that the capping unit 6 is opened to the air, and then the pump 23 is operated again so as to remove the ink splashed onto the nozzle surface 1a during the suction of ink; that is, a false suction is carried out. However, with this false suction omitted, the capping unit 6 is disengaged from the nozzle surface, and the recording head 1 is moved to the printing region. And when the recording head has passed through the cleaning element 30 (Step 73 of FIG. 9), the electromagnetic plunger 21 is energized to jerk the cleaning element 30 into the path of movement of the nozzle opening 1a (FIG. 10b). Thereafter, the recording head 1 is moved in the opposite direction, towards the capping unit 6 in the direction of the arrow D in FIG. 10c (Step 75 in FIG. 9), so that the rubbing member 34 is elastically brought into contact with the nozzle surface 1a.

In the case of the ink discharge restoring operation in which the false suction is not carried out, ink remains on the nozzle surface 1a of the recording head 1. The ink is absorbed by the rubbing member 34; that is, the latter 34 is wetted with the ink. When, under this condition, the recording head 1 is moved towards the capping unit 6, similarly as in the above-described case the wet rubbing member 34 rubs the nozzle surface 1a to wipe off ink, dust and fibers coming out of the recording medium from the nozzle surface 1a.

When it is required to perform the wiping operation again (Step 76 in FIG. 9), the recording head 1 is moved in the opposite direction, towards the recording region. In this operation, similarly as in the above-described case the blade member 33 is brought into contact with the nozzle surface, to scrape the layer of ink off the latter (Step 77 in FIG. 9, and FIG. 10d).

In the above-described cleaning method, it is unnecessary to perform a flushing operation for the cleaning element 30, and therefore the difficulty that ink is splashed when flushed is eliminated. That is, the inside of the printer housing is prevented from being made dirty with ink.

A case where a cleaning operation is selected as the need arises will be described with reference to FIGS. 11, 12, 13 and 14.

In a cleaning operation, the rubbing operation made by the rubbing member 34 in not always necessary, that is, there in a case where the wiping operation is sufficient to remove contaminators from a recording head. In this case, only the wiping operation is performed. On the contrary, if one wiping operation was insufficient to remove contaminators from the recording head, further the rubbing operation is performed. Instead, initially one rubbing operation is performed, and if the contaminators have not yet been removed from the recording head, the rubbing operation may be repeated several times, for example, five times.

A timing control means 20 will be described with reference to FIG. 11.

The timing control means 20, as shown in FIG. 11, is composed of a microcomputer 203 including a CPU 200, a ROM 201 and a RAM 202, a clock circuit 204 and a memory 205 for storing a time when a cleaning instruction button, which is provided on the operating panel of an ink jet type recording apparatus body, is pushed. When the

cleaning instruction button is pushed, a position detector 304 (FIG. 12) produces a signal. At this time, the timing control means 20 outputs a signal to the solenoid drive means 22 (FIG. 2) to energize the electromagnetic plunger 21 so that the cleaning unit 5 is moved towards the recording head 1. The timing control means 20 also outputs a signal to the carriage driving means 28 to perform a cleaning operation which has been previously programmed.

FIG. 12 is a block diagram illustrating a model of the function to be realized by the microcomputer 203 of FIG. 11. The circuit shown in FIG. 12 is constituted by a time difference calculation means 300 for calculating a time difference ΔT between a time data when previously pushing the cleaning instruction button and a time when pushing the cleaning instruction button at present, a reference time setting means 301 for setting and storing a reference time T_0 to judge a type of printing defect, a comparing means 302 for comparing the time difference data ΔT output from the time difference calculation means 300 with the reference time T_0 stored in the reference time setting means 301. The circuit also includes a rubbing operation setting means 303, a solenoid driving means 22 and a carriage driving means 28 to control, on the basis of the result of the comparison, the operation of the rubbing member 34 enough to remove solidified ink, dust, fibers, etc. from the nozzle surface of the recording head.

In this embodiment, a cleaning operation is selected on the basis of a time difference when pushing the cleaning instruction button. The same effect can be also obtained by controlling an ink suction time or ink suction quantity due to the capping unit 6 in response to a printing quantity or a paper food quantity.

This embodiment will be described with reference to FIG. 13.

FIG. 13 is a block diagram showing a timing control means 20 which is constituted by a microcomputer 404 including a CPU 401, a ROM 402 and a RAM 403, a counter 405 for counting an integrating print quantity such as the number of printed characters, the number of lines, and the amount of paper feed, and a memory 407 for storing data of the integrating print quantity from the counter 405 when a cleaning instruction button, which is provided on the operating panel of an ink jet type recording apparatus body, is pushed. When a cleaning operation instruction button is pushed, a position detector 304 (FIG. 14) produces a signal. At this time, the timing control means 20 outputs a signal to a solenoid driving means 22 (FIG. 2) to energize an electromagnetic plunger 21 so that the cleaning unit 5 is moved towards the recording head 1. Also, the timing control means 20 outputs a signal to a carriage driving means 28 to perform a cleaning operation previously programmed.

FIG. 14 is a block diagram showing a model of the function to be realized by the microcomputer 404 of FIG. 13. The circuit shown in FIG. 14 is composed of a print quantity difference calculation means 408 for calculating a print quantity difference ΔL between print quantity data stored in the memory 407 and data in the counter 405 when the cleaning instruction button is pushed, a reference print quantity setting means 409 for setting and storing a reference print quantity L_0 to judge a type of printing defect, a comparing means 410 for comparing data of the print quantity difference sent from the print quantity difference calculation means 408 with the reference print quantity L_0 from the reference print quantity setting means 409. The circuit is also composed of a rubbing operation setting means 303, a solenoid driving means 22 and a carriage driving means 28 to control, on the basis of the result of the comparison, the operation of the rubbing member 34 enough to remove solidified ink, dust, fibers, etc. from the nozzle surface of the recording head.

The operation of the apparatus thus arranged will be then described with respect to FIGS. 15 and 16.

In FIG. 15, Steps 110 through 119 correspond to Steps 60 through 69 in FIG. 4, and their description will be omitted here. After performing the ink discharge restoring operation (Step 111 in FIG. 15), a time difference ΔT between a time when previously pushing the cleaning instruction button and the present time is calculated (Step 120). Then, the time difference ΔT thus calculated is compared with the predetermined reference time T_0, and as a result of the comparison, if ΔT is smaller than T_0, then it is judged that contaminators have not been sufficiently removed from the recording head by the previous cleaning operation (Step 121). In this case, the operation of Steps 112 through 119 is performed. On the other hand, if ΔT is not smaller than T_0, then it is judged that contaminators have been sufficiently removed from the recording head by the previous cleaning operation, and only the wiping operation is carried out as a first cleaning operation (Steps 122 and 123).

In the cleaning method of FIG. 15, a cleaning operation is selected on the basis of a time difference between a time when performing the previous cleaning operation and the present time. However, a cleaning operation may be selected on the basis of a difference between an integrating print quantity at the time of the previous cleaning operation and the present integrating print quantity. This embodiment will be described with respect to FIG. 16.

In FIG. 16, Steps 90 through 99 correspond to Steps 60 through 69 of FIG. 4, and therefore their description will be omitted. After the discharge restoring operation (Step 91 in FIG. 16), a difference ΔL between an integrating print quantity when previously pushing a cleaning instruction button and the present integrating print quantity is calculated (Step 100). Then, the difference ΔL thus calculated is compared with a predetermined reference print quantity L_0, as a result of which if ΔL is smaller than L_0, then it is judged that contaminators have been insufficiently removed from the recording head by the previous cleaning operation (Step 101). In this case, the operation of Steps 92 through 99 is performed. On the other hand, if ΔL is not smaller than L_0, then it is judged that contaminators have been sufficiently removed from the recording head by the previous cleaning operation, and then only the wiping operation is carried out as a first cleaning operation. (Steps 102 and 103).

In the cleaning operation described above, if contaminators have not yet been removed from the recording head by the first cleaning operation, the cleaning instruction button is pushed again after printing to perform the cleaning operation shown in FIG. 15 or 16. At this time, a specific cleaning method may be set, for example, the operation of Steps 112 to 117 or Steps 92 to 97 is repeated several times such as five times. Also, in the second cleaning operation, the times of allowing the recording head to abut against the blade may be set to a plurality of times.

FIGS. 17a through 17c show another example of the cleaning unit. The cleaning unit is moved by the torque of the platen 3.

The rotary shaft 3a of the platen 3 is supported by an intermediate frame 80. A frictional disk 81 is fixedly mounted on the end portion of the rotary shaft 3a thus supported. A compression spring 82 and a cleaner opening and closing plate 83 are arranged between the intermediate frame 80 and the frictional disk 81 in such a manner that the plate 83 is pushed against the frictional disk by the compression spring 82. Hence, the plate 83 is turned in synchronization with the rotation of the platen 3, and when regulated by a rotation regulating member, it is allowed to slide on the frictional disk 81.

In FIGS. 17a through 17c, reference numeral 30 designates the above-described cleaning element. The cleaning element 30, as shown in FIG. 17b, is rotatably supported through a supporting member 84 on a shaft 85 which is fixedly secured to the intermediate frame 80. A pin 86 embedded in the supporting member 84 is engaged with an arcuate groove 87 which is formed in the cleaner opening and closing plate 83 in such a manner that its radius is increased with the displacement of the platen 3 in the sheet feeding direction.

When the cleaner opening and closing plate 83 is operated in association with the rotation of the platen 3, the supporting member 84 in turned about the shaft 85, so that, as shown in FIG. 17c, the cleaning element 30 is retracted to the position where it is not brought into contact with the nozzle surface 1a of the recording head 1. Even when, under this condition, the platen 3 is further turned in the sheet feeding direction, the cleaning element is not displaced because the cleaner opening and closing plate 83 is allowed to slide on the frictional disk 81.

When, under this condition, the platen 3 is turned in the opposite direction (in the direction opposite to the sheet feeding direction), the cleaning element 30 is moved as shown in FIG. 17b. With the cleaning unit thus constructed, even if, in the case where the cleaning element 30 is protruded after the recording head 1 has been moved to the position here it is confronted with the cleaning element 30, it in tried to push the cleaning element 30 against the nozzle surface 1a with a load higher than a certain value, the cleaning element 30 will slide. Hence, even when the position of the recording head 1 with respect to the platen 3 is adjusted by moving it back and forth according to the thickness of a recording medium, the cleaning element 30 can be brought into contact with the recording head 1 under a predetermined pressure.

In the above-described cleaning unit, it is unnecessary to use drive means such as an electromagnetic plunger, and the power of the motor 10 for driving the platen 3 can be utilized. Hence, the cleaning unit is simple in construction.

The cleaning operation has been described which is carried out when the recording apparatus is in use. However, it goes without saying that the above-described method can be used for cleaning an new ink jet type recording apparatus which has been just procured.

In general, until an ink jet type recording apparatus is delivered from the factory to a user, the recording head is held filled with a solution called "shipping solution" so as to allow the wall of the ink flowing path to have affinity or attraction for ink, thus being maintained unchanged in quality. The shipping solution, being different from ink, is lower in volatility and higher in viscosity than ink. Hence, it is essential to completely remove the shipping solution from the nozzle surface when the recording apparatus is used for the first time; otherwise the resultant print would be unsatisfactory in picture quality. In this case, the use of the rubbing member of the cleaning element is markedly effective in removal of the shipping solution.

Claims

1. An ink jet type recording apparatus comprising:

a recording head (1) having at least one nozzle on a nozzle surface for jetting ink droplets from said nozzle to form a dot pattern on a recording medium;

cleaning means (5) for cleaning the nozzle surface of said recording head (1), said cleaning means being moved in and out of the path of movement of said recording head when required; and

drive means (21) for moving said cleaning means (5) to a position where said cleaning means (5) is brought into contact with the nozzle surface of said recording head and to a position where said cleaning means is not in contact therewith;

wherein said cleaning means (5) comprises:

a spatula-shaped elastic blade member (33); and

a water-absorbing rubbing member (34) bonded to said blade member (33), and

one of the edges (35,36) of said blade member (33) and said rubbing member (34) is selectively brought into contact with the nozzle surface of said recording head with the aid of the elasticity of said blade member (33).

2. An apparatus as claimed in claim 1, in which, said blade member (33) and said rubbing members (34) are so arranged that said blade member (33) is on the side of a standby position provided for said recording head (1) while said rubbing member (34) is on the side of a printing region.

3. An apparatus as claimed in claim 1 or 2, in which said blade member (33) is made of a rubber material, and said rubbing member (34) is made of unwoven cloth.

4. An apparatus as claimed in any one of the preceding claims, in which said blade member (33) and said rubbing member (34) are bonded together with an adhesive of silicon or rubber series.

5. An apparatus as claimed in any one of the preceding claims, wherein said drive means comprises friction gearing means which receives drive power from platen driving means (10) in an apparatus body.

6. A method of cleaning a nozzle surface of a recording head for use in an ink jet type recording apparatus comprising a recording head of ink jet type with a nozzle surface for jetting ink droplets from a nozzle to form a dot pattern on a recording medium; and cleaning means for cleaning said nozzle surface of said nozzle surface, said cleaning means being moved in and out of the path of movement of said recording head when required, and comprising a spatula-shaped elastic blade member and a water-absorbing rubbing member bonded to said blade member, said method comprising the steps of:

jetting ink from said recording head to wet said rubbing member; and

cleaning the nozzle surface of said recording head by said rubbing member.

7. A method especially according to claim 6, of cleaning a recording head for use in an ink jet type recording apparatus comprising a recording head for jetting ink droplets from a nozzle to form a dot pattern on a recording medium; and cleaning means which is moved in and out of the path of movement of said recording head when required, and comprising a spatula-shaped elastic blade member and a water-absorbing rubbing member bonded to said blade member, said method comprising the steps of:

applying negative pressure to said recording head to forcibly discharge ink therefrom so that the nozzle surface of said recording head is wet with the ink; and

cleaning the nozzle surface of said recording head by said rubbing member.

8. An ink jet type recording apparatus especially according to any one of claims 1 to 5 or 7, comprising:

a recording head (1) having at least one nozzle for jetting ink droplets from said nozzle to form a dot pattern on a recording medium;

means (5) for cleaning said recording head (1), said cleaning means being capable of performing a wiping operation and a rubbing operation;

means (21) for driving said cleaning means;

means for generating a cleaning instruction signal;

means (20) for controlling the operation of said cleaning means, wherein said control means (20) comprising:

means for previously setting a reference time to store said reference time;

means for calculating a time difference between a time when said instruction means has previously generated said cleaning instruction signal and a present time;

means for comparing said time difference with said reference time; and

means for sending, in response to the result of said comparison, a signal to said cleaning drive means so that said cleaning means performs said rubbing operation if said time difference is smaller than said reference time, and so that said cleaning means performs said wiping operation if said time difference is not smaller than said reference time.

9. An ink jet type recording apparatus especially according to claim 1, comprising:

a recording head (1) having at least one nozzle for jetting ink droplets from said nozzle to form a dot pattern on a recording medium;

means (6) for cleaning said recording head, said cleaning means being capable of selectively performing a wiping operation and a rubbing operation;

means (21) for driving said cleaning means;

means for generating a cleaning instruction signal;

means (20) for controlling the operation of said cleaning means, wherein said control means comprising:

means for previously setting a reference print quantity to store said reference quantity;

means for calculating a difference between an integrating print quantity when said instruction means has previously generated said cleaning instruction signal and a present integrating print quantity;

means for comparing said difference with said reference print quantity; and

means for outputting, in response to the result of said comparison, a signal to said cleaning drive means so that said cleaning means performs said rubbing operation if said difference is smaller than said reference print quantity and so that said cleaning means performs said wiping operation if said difference is not smaller than said reference print quantity.

10. A method of cleaning a nozzle surface of a recording head especially according to claim 6 or 7, for use in an ink jet type recording apparatus which comprises an ink jet recording head for jetting an ink droplet from a nozzle to form a dot pattern on a recording medium and a recording head cleaning means movable in and out of the path of movement of said recording head and comprising a spatula-shaped elastic blade member and a water-absorbing rubbing member, said method comprising the steps of:

operating a time difference between a time of a previous cleaning operation and a present time;

comparing said time difference with a predetermined reference time; and

on the basis of the result of said comparing step, allowing said nozzle surface of said recording head to selectively abut against one of said blade member and said rubbing member.

11. A method as claimed in Claim 10, wherein the times of allowing said nozzle surface of said recording head to abut against one of said blade member and said rubbing member is more than the times of previous abutting operation.

12. A method of cleaning a nozzle surface of a recording head especially according to claims 6,7,10, 11 for use in an ink jet type recording apparatus which comprises an ink jet recording head for jetting an ink droplet from a nozzle to form a dot pattern on a recording medium and a recording head cleaning means movable in and out of the path of movement of said recording head and comprising a spatula-shaped elastic blade member and a water-absorbing rubbing member, said method comprising the steps of:

operating a difference between an integrating

print quantity when previously performing a cleaning operation and a present integrating print quantity;

comparing said difference of the integrating print quantity with a predetermined reference print quantity; and

on the basis of the result of said comparing step, allowing said nozzle surface of said recording head to selectively abut against one of said blade member and said rubbing member.

13. A method as claimed in Claim 12, wherein the times of allowing said nozzle surface of said recording head to abut against one of said blade member and said rubbing member is more than the times of previous abutting operation.

14. An ink jet type recording apparatus especially according to any one of claims 1-5,8, and 9, comprising:

an ink jet recording head (1) for jetting an ink droplet from a nozzle to form a dot pattern on a recording medium;

means (6) for cleaning said recording head, said cleaning means being movable in and out of the path of movement of said recording head and comprising a spatula-shaped elastic blade member (33) and a water-absorbing rubbing member (34);

means (20) for operating a time difference between a time of a previous cleaning operation and a present time;

means for comparing said time difference with a predetermined reference time; and

means for allowing said nozzle surface of said recording head (1) to selectively abut against one of said blade member (33) and said rubbing member (34) on the basis of the result of said comparing step.

15. An apparatus as claimed in Claim 14, wherein said abutting means allows said nozzle surface of said recording head to abut against one of said blade member and said rubbing member more times than those of previous abutting operation.

16. An ink jet type recording apparatus, especially according to any one of claims 1 to 5, 8, 9, 14 and 15, comprising:

an ink jet recording head (1) for jetting an ink droplet from a nozzle to form a dot pattern on a recording medium;

means (5) for cleaning said recording head, said cleaning means being movable in and out of the path of movement of said recording head and comprising a spatula-shaped elastic blade member (33) and a water-absorbing rubbing member (34);

means for operating a difference between an integrating print quantity when previously performing a cleaning operation and a present integrating print quantity;

means for comparing said difference of the integrating print quantity with a predetermined reference print quantity; and

means for allowing said nozzle surface of said recording head to selectively abut against one of said blade member (33) and said rubbing member (34) according to a signal from said comparing means.

17. An apparatus as claimed in Claim 16, wherein said abutting means allows said nozzle surface of said recording head (1) to abut against one of said blade member (33) and said rubbing member (34) more times than those of previous abutting operation.

FIG. 1

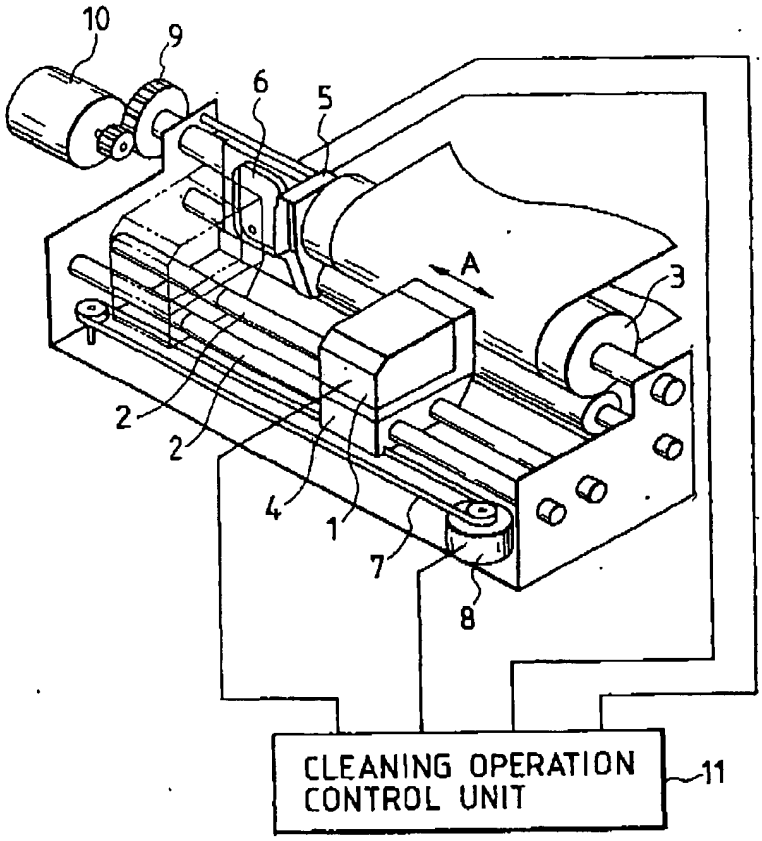

10
9
6
5
A
3
2
2
4
1
7
8
CLEANING OPERATION CONTROL UNIT
11

FIG. 3

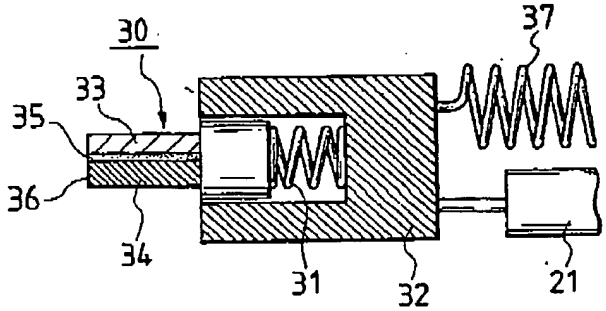

30
37
33
35
36
34
31
32
21

FIG. 2

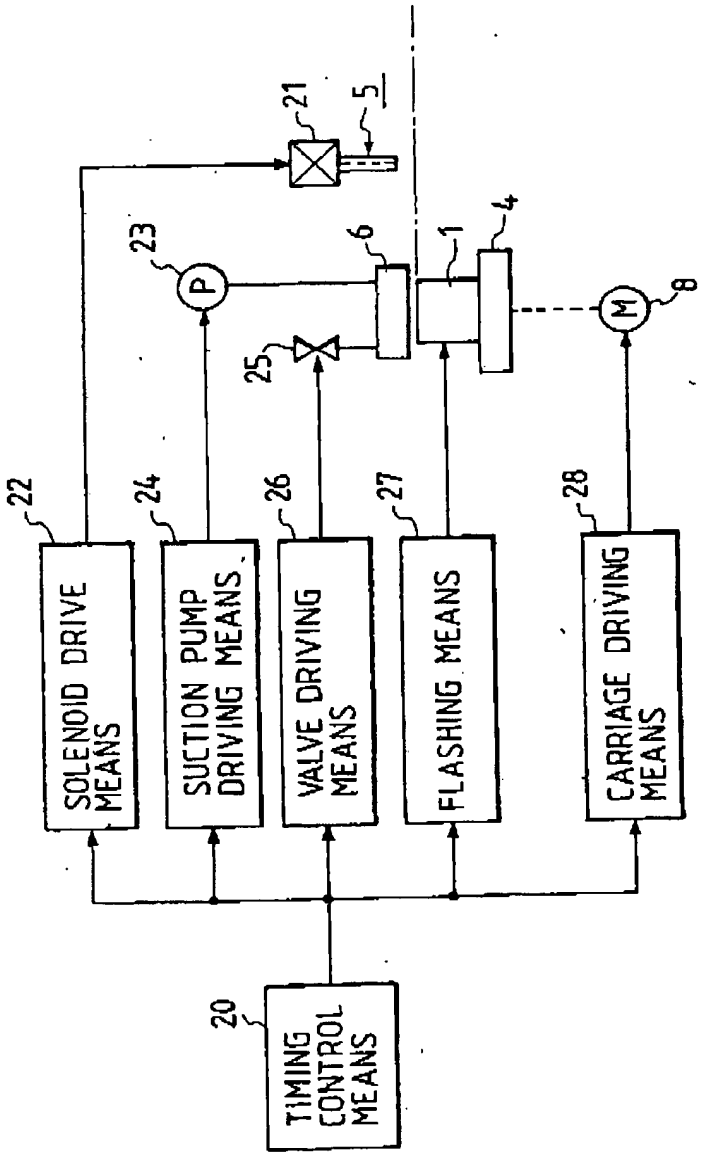

21
5
23
6
1
4
P
M
8
25
22
24
26
27
28
SOLENOID DRIVE MEANS
SUCTION PUMP DRIVING MEANS
VALVE DRIVING MEANS
FLASHING MEANS
CARRIAGE DRIVING MEANS
20
TIMING CONTROL MEANS

FIG. 4

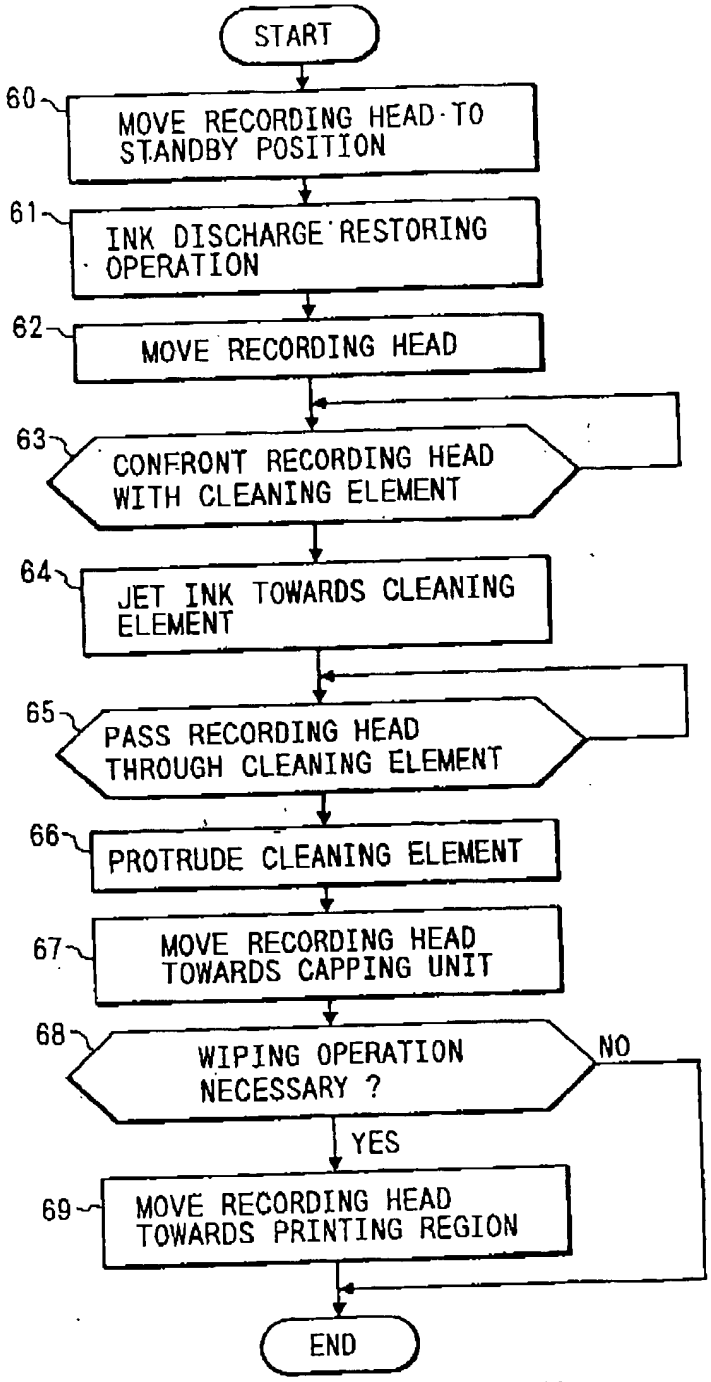

START
60
MOVE RECORDING HEAD TO STANDBY POSITION
61
INK DISCHARGE RESTORING OPERATION
62
MOVE RECORDING HEAD
63
CONFRONT RECORDING HEAD WITH CLEANING ELEMENT
64
JET INK TOWARDS CLEANING ELEMENT
65
PASS RECORDING HEAD THROUGH CLEANING ELEMENT
66
PROTRUDE CLEANING ELEMENT
67
MOVE RECORDING HEAD TOWARDS CAPPING UNIT
68
WIPING OPERATION NECESSARY ?
NO
YES
69
MOVE RECORDING HEAD TOWARDS PRINTING REGION
END

FIG. 5a

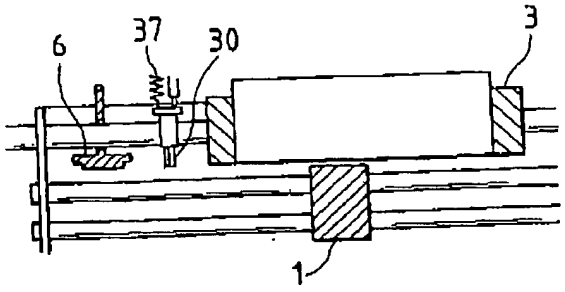


FIG. 5b

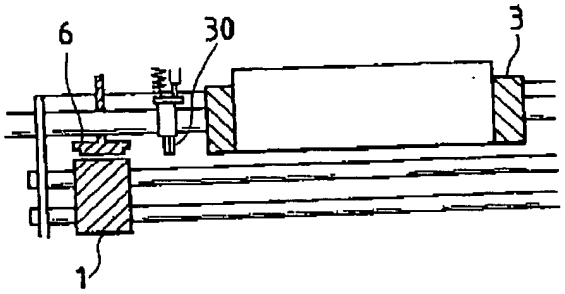


FIG. 5c

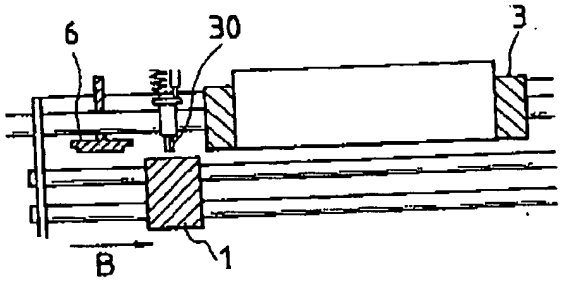


FIG. 5d

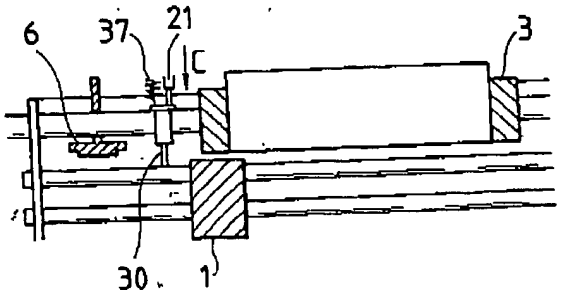


FIG. 6a

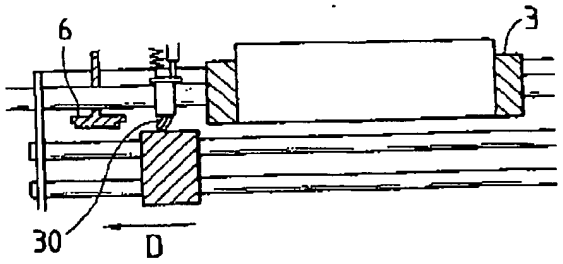


FIG. 6b

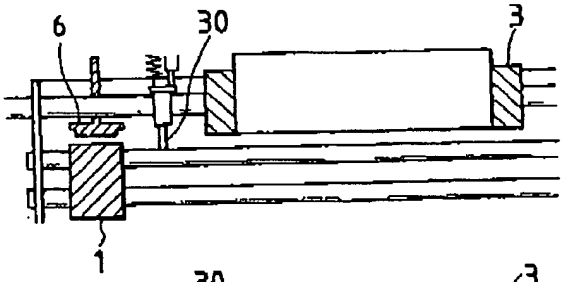


FIG. 6c

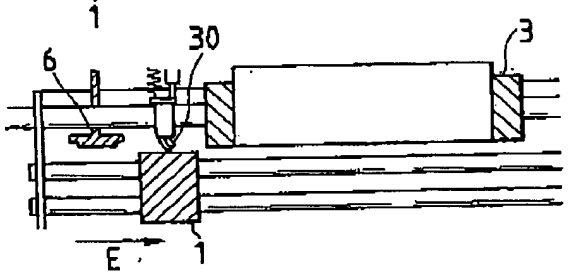


FIG. 6d

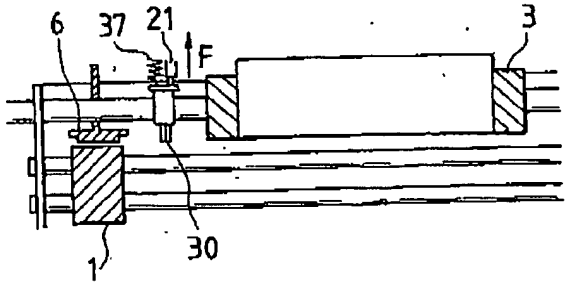


FIG. 7a

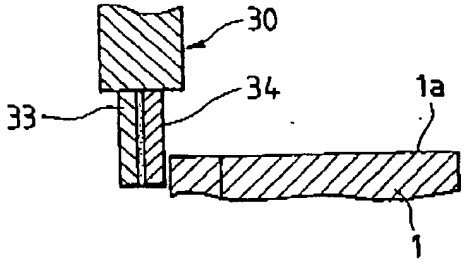


FIG. 7b

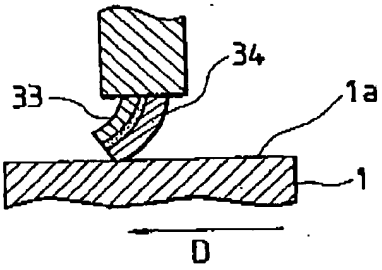


FIG. 8a

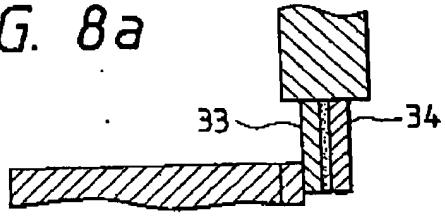


FIG. 8b

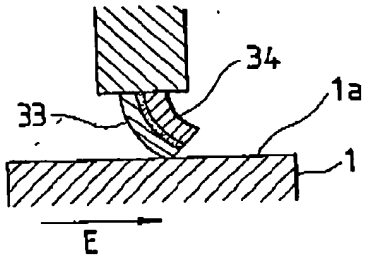


FIG. 9

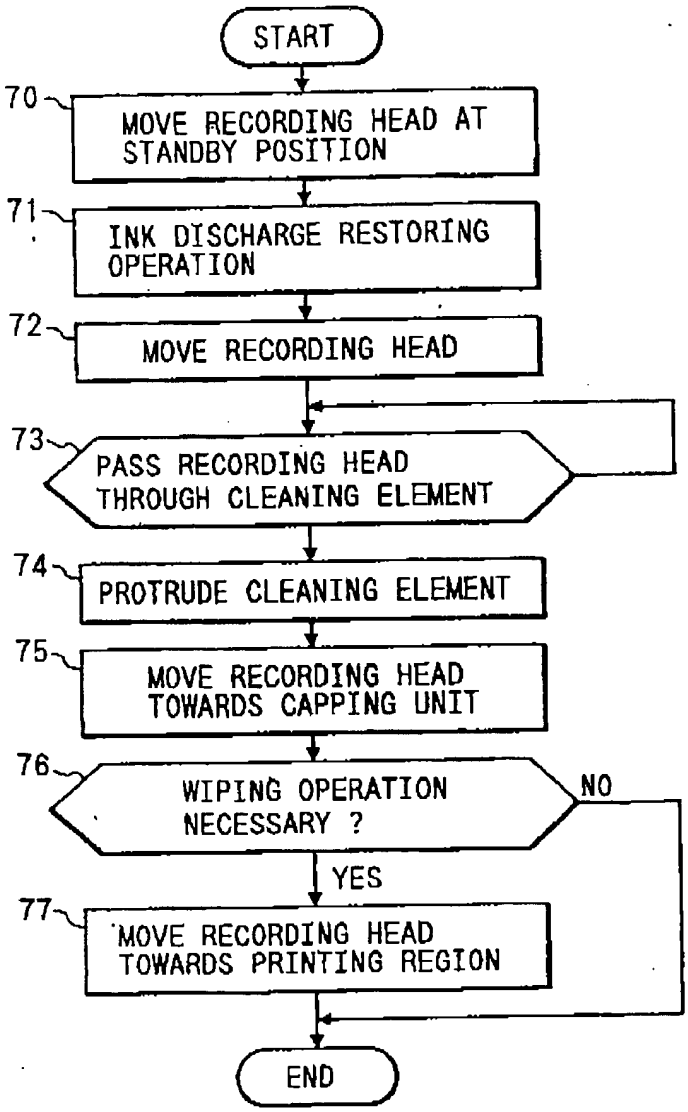

START
70
MOVE RECORDING HEAD AT STANDBY POSITION
71
INK DISCHARGE RESTORING OPERATION
72
MOVE RECORDING HEAD
73
PASS RECORDING HEAD THROUGH CLEANING ELEMENT
74
PROTRUDE CLEANING ELEMENT
75
MOVE RECORDING HEAD TOWARDS CAPPING UNIT
76
WIPING OPERATION NECESSARY ?
NO
YES
77
MOVE RECORDING HEAD TOWARDS PRINTING REGION
END

FIG. 10a

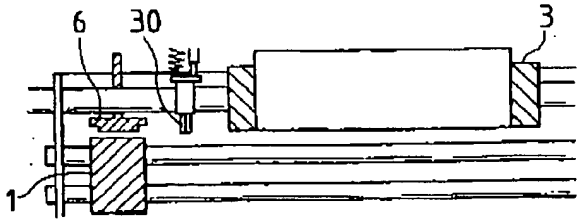


FIG. 10b

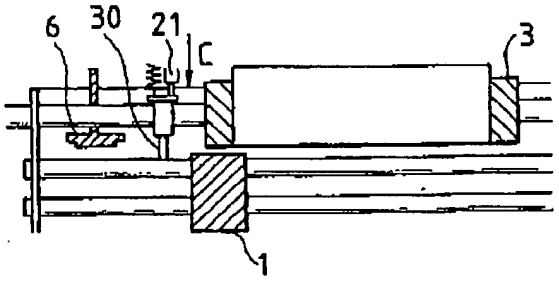


FIG. 10c

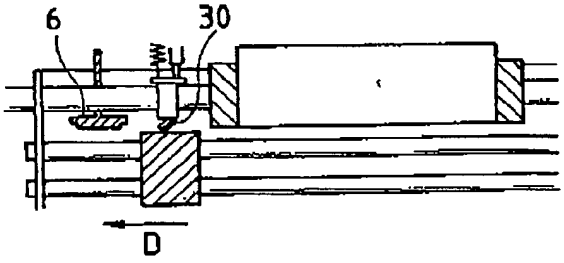


FIG. 10d

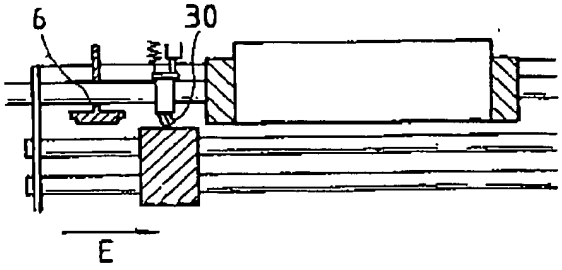


FIG. 11

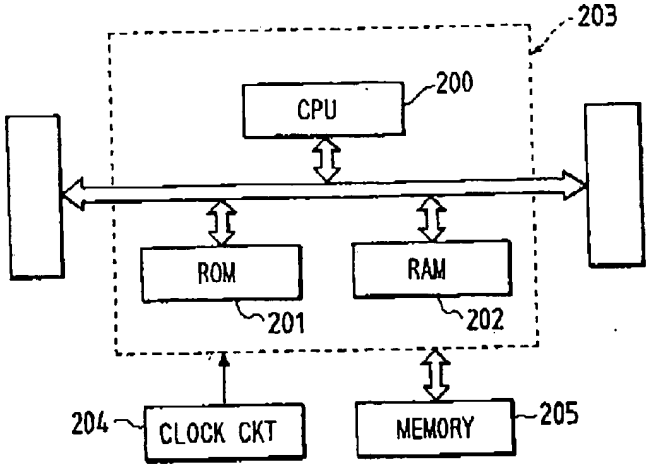

203
CPU
200
ROM
RAM
201
202
204
CLOCK CKT
MEMORY
205

FIG. 12

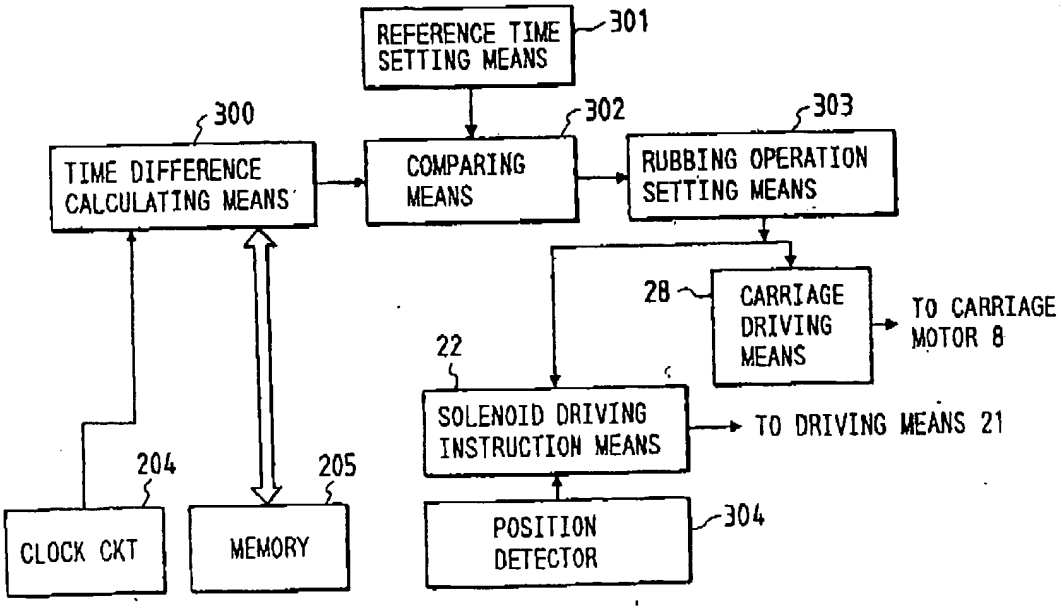

REFERENCE TIME SETTING MEANS
301
300
TIME DIFFERENCE CALCULATING MEANS
302
COMPARING MEANS
303
RUBBING OPERATION SETTING MEANS
28
CARRIAGE DRIVING MEANS
TO CARRIAGE MOTOR 8
22
SOLENOID DRIVING INSTRUCTION MEANS
TO DRIVING MEANS 21
204
205
CLOCK CKT
MEMORY
POSITION DETECTOR
304

FIG. 13

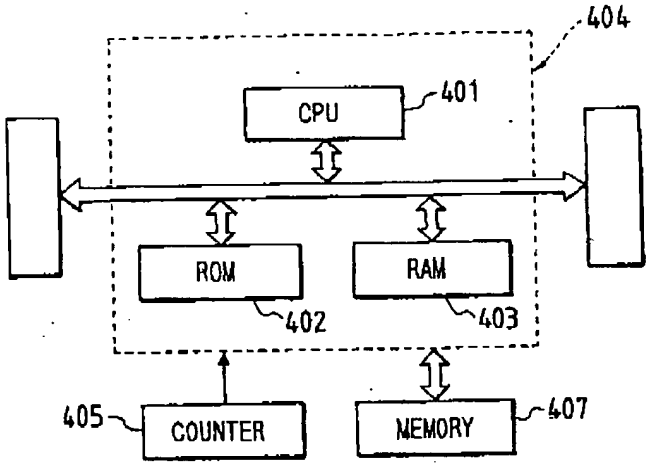

404
CPU
401
ROM
RAM
402
403
405
COUNTER
MEMORY
407

FIG. 14

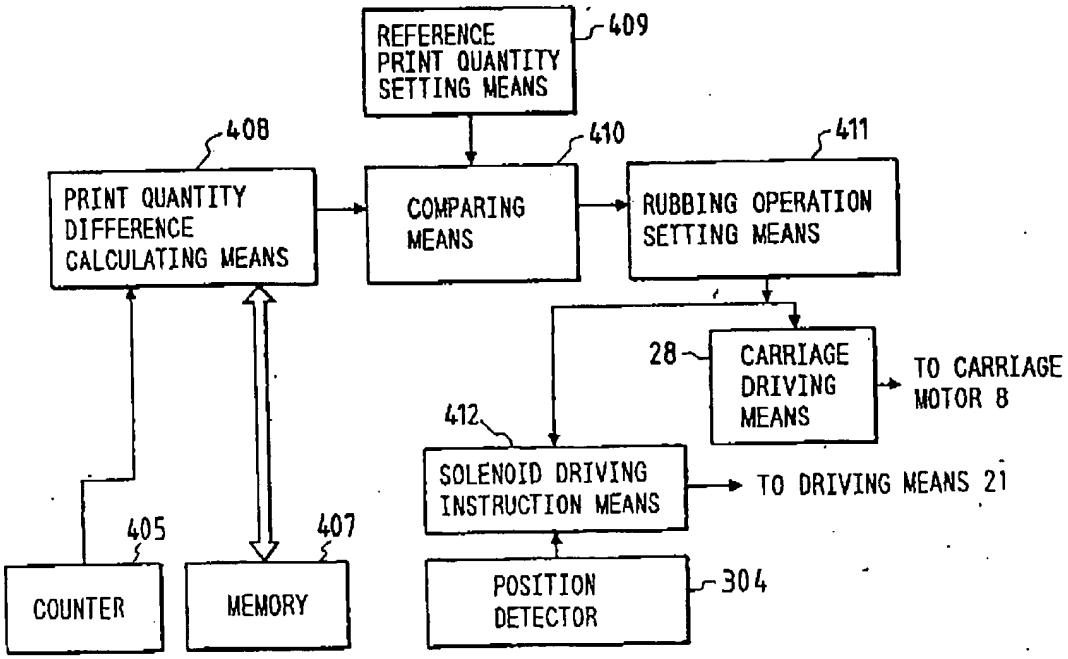

REFERENCE PRINT QUANTITY SETTING MEANS
409
408
PRINT QUANTITY DIFFERENCE CALCULATING MEANS
410
COMPARING MEANS
411
RUBBING OPERATION SETTING MEANS
28
CARRIAGE DRIVING MEANS
TO CARRIAGE MOTOR 8
412
SOLENOID DRIVING INSTRUCTION MEANS
TO DRIVING MEANS 21
405
407
COUNTER
MEMORY
POSITION DETECTOR
304

FIG. 15

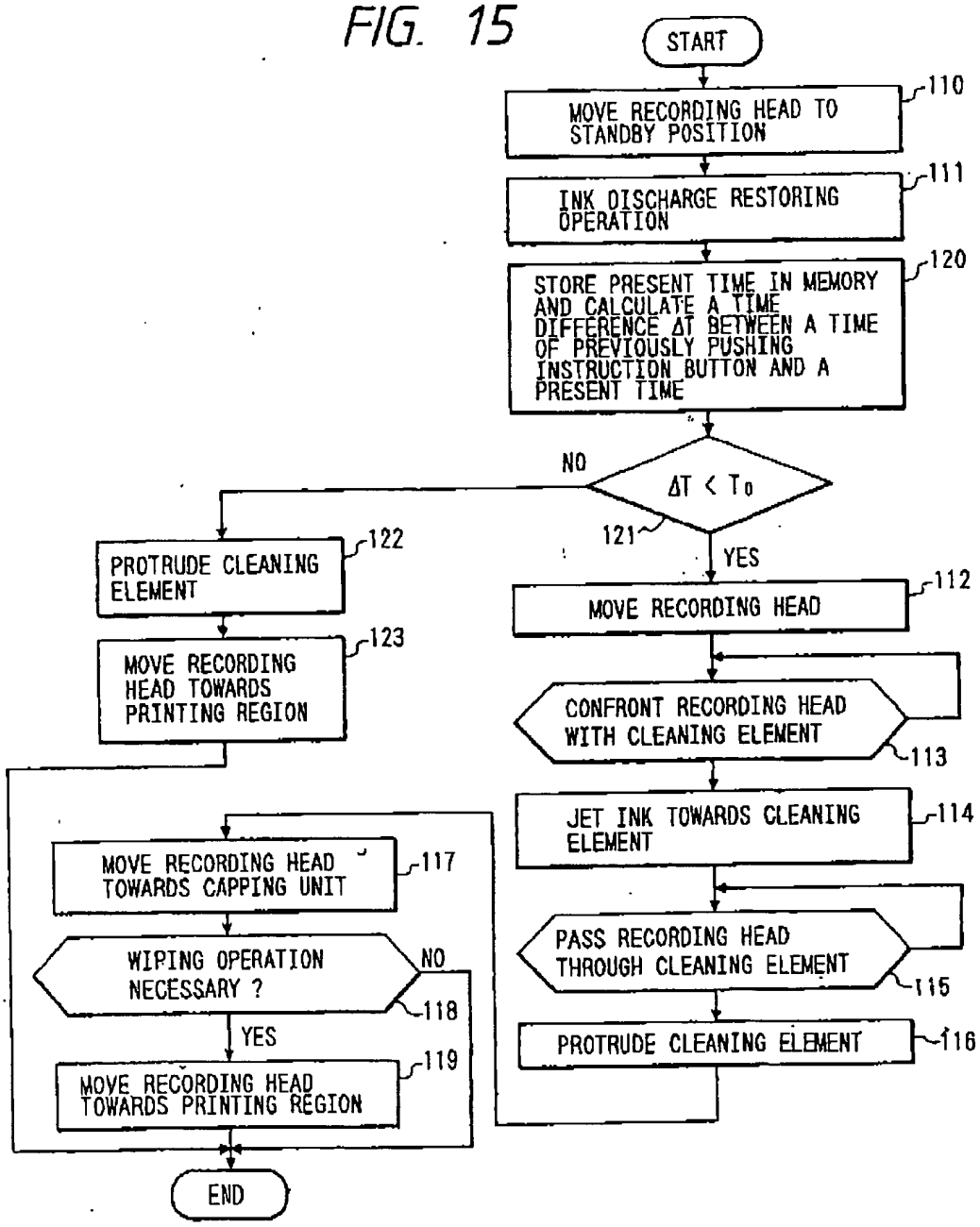

START
MOVE RECORDING HEAD TO STANDBY POSITION
110
INK DISCHARGE RESTORING OPERATION
111
STORE PRESENT TIME IN MEMORY AND CALCULATE A TIME DIFFERENCE ΔT BETWEEN A TIME OF PREVIOUSLY PUSHING INSTRUCTION BUTTON AND A PRESENT TIME
120
ΔT < To
NO
121
YES
PROTRUDE CLEANING ELEMENT
122
MOVE RECORDING HEAD TOWARDS PRINTING REGION
123
MOVE RECORDING HEAD
112
CONFRONT RECORDING HEAD WITH CLEANING ELEMENT
113
JET INK TOWARDS CLEANING ELEMENT
114
PASS RECORDING HEAD THROUGH CLEANING ELEMENT
115
PROTRUDE CLEANING ELEMENT
116
MOVE RECORDING HEAD TOWARDS CAPPING UNIT
117
WIPING OPERATION NECESSARY ?
NO
118
YES
MOVE RECORDING HEAD TOWARDS PRINTING REGION
119
END

FIG. 16

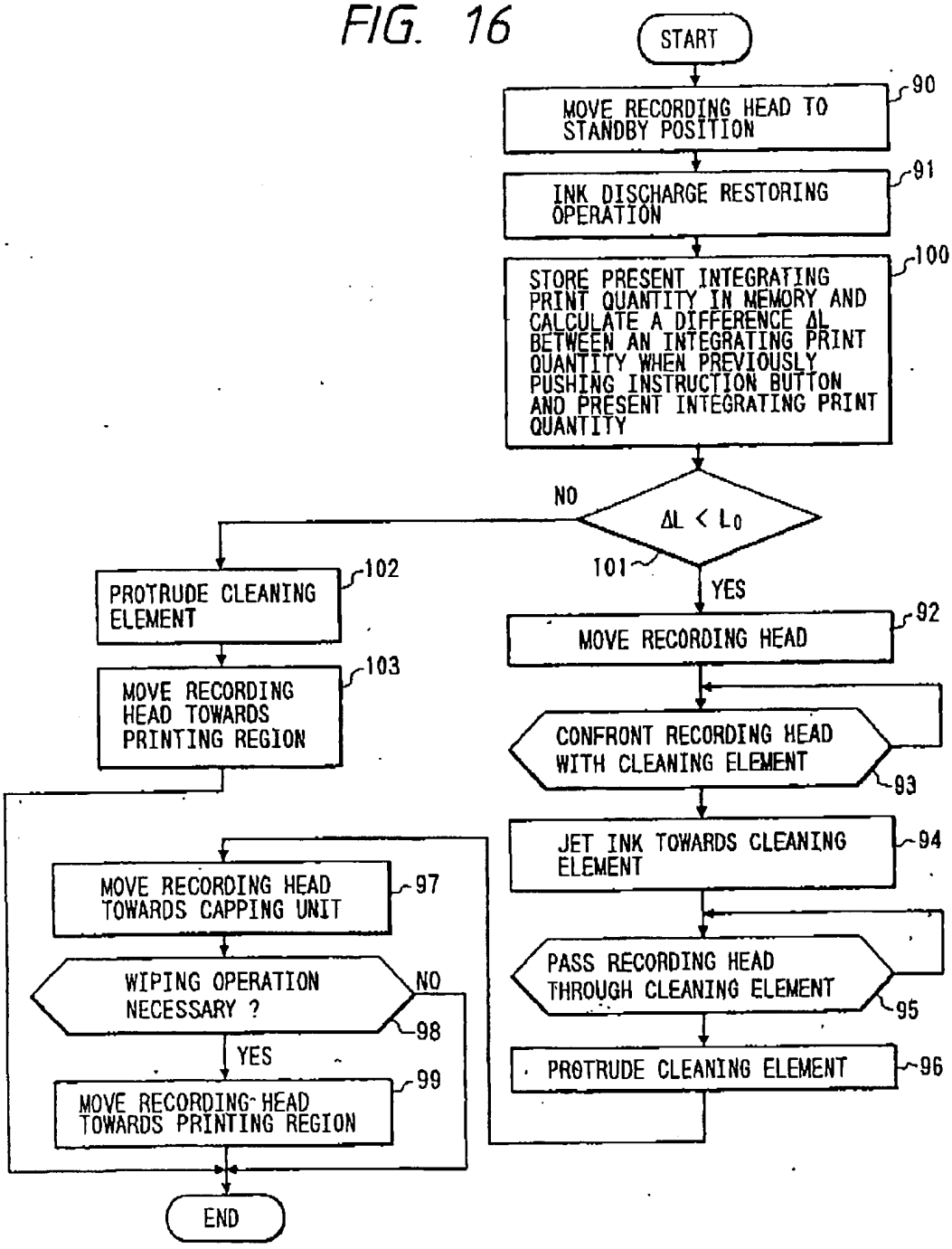

START
MOVE RECORDING HEAD TO STANDBY POSITION
90
INK DISCHARGE RESTORING OPERATION
91
STORE PRESENT INTEGRATING PRINT QUANTITY IN MEMORY AND CALCULATE A DIFFERENCE ΔL BETWEEN AN INTEGRATING PRINT QUANTITY WHEN PREVIOUSLY PUSHING INSTRUCTION BUTTON AND PRESENT INTEGRATING PRINT QUANTITY
100
ΔL < L0
101
NO
YES
PROTRUDE CLEANING ELEMENT
102
MOVE RECORDING HEAD TOWARDS PRINTING REGION
103
MOVE RECORDING HEAD
92
CONFRONT RECORDING HEAD WITH CLEANING ELEMENT
93
JET INK TOWARDS CLEANING ELEMENT
94
PASS RECORDING HEAD THROUGH CLEANING ELEMENT
95
PROTRUDE CLEANING ELEMENT
96
MOVE RECORDING HEAD TOWARDS CAPPING UNIT
97
WIPING OPERATION NECESSARY ?
98
NO
YES
MOVE RECORDING HEAD TOWARDS PRINTING REGION
99
END

FIG. 17a

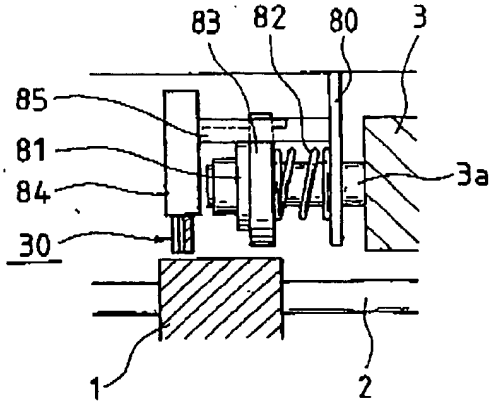


FIG. 17b

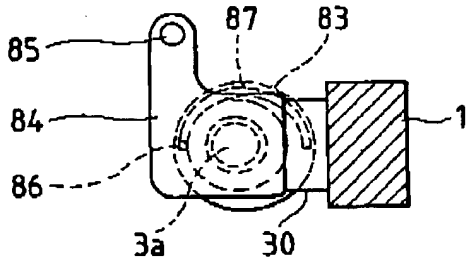
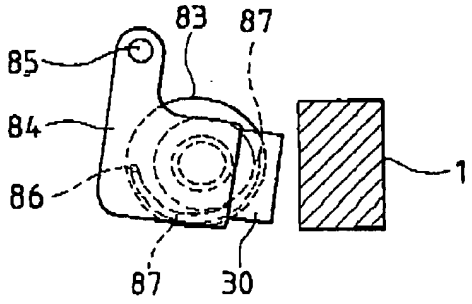


FIG. 17c



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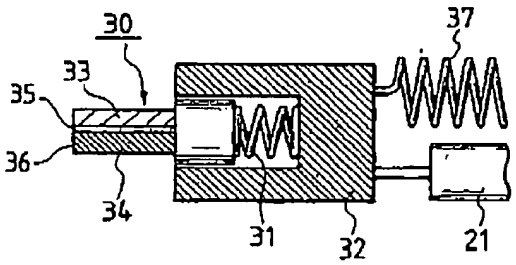
(54) Ink jet type recording apparatus and method of cleaning a recording head.

(57) An ink jet type recording apparatus comprises a recording head (1) of ink jet type for jetting ink droplets from a nozzle to form a dot pattern on a recording medium and a cleaning unit (5) which is moved in and out of the path of movement of the recording head when required, and made up of a spatula-shaped elastic blade member (33) and a water-absorbing rubbing member (34) bonded to the member. In the case where the nozzle surface of the recording head is to be cleaned with the rubbing member, the cleaning operation is carried out with the rubbing member (34) wetted with ink. In cleaning the nozzle surface with the blade member (33), the latter is abutted against the recording head (1) as it is.

FIG. 3



EP 0 513 833 A3

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 92 10 8287

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	EP-A-0 395 004 (CANON K.K.) * column 11, line 1 - column 12, line 31; claim 3; figure 2 *	1-3,5-7	B41J2/165
A	EP-A-0 323 261 (CANON K.K.) * column 6, line 13 - line 30; figure 4 *	1-17	
D,A	US-A-4 951 066 (TERASAWA) * the whole document *	1-17	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			B41J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	30 NOVEMBER 1992	JOOSTING T.E.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
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